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AIR QUALITY INVESTIGATIONS CONDUCTED IN THE TOWN OF SMOOTH ROCK FALLS

1974 to 1984

APRIL, 1987

Ontario
Ministry of the Environment

W.J. GIBSON, Director
Northeastern Region

Air Quality Investigations Conducted in the Town of Smooth Rock Falls

1974 to 1984

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I. Summary

Since 1974, the Ontario Ministry of the Environment has conducted various investigations on the impact of atmospheric emissions from the Abitibi-Price Kraft Mill at Smooth Rock Falls, Ontario.

Settleable particulate was monitored in the Town, using the dustfall jar technique, from June, 1977 to July, 1980. Calcium and sulphates in settleable particulate were also monitored at each of the locations. The results show that the total dustfall levels were generally within the Provincial criteria and that the impact of particulate emissions from the mill on the local air quality was minor. Although, in general, there were no obvious trends or patterns in the data, some of the sites showed a marginal decrease in total dustfall, calcium and sulphate coinciding with the installation of particulate abatement equipment at the mill in 1978.

A program of vegetation and soil sampling was carried out in 1974, 1975, 1976, 1977 and 1983. The results of this program indicated that concentrations above background of calcium, sodium and chloride in the foliage were common in the vicinity of the Kraft mill. The concentrations of calcium decreased in 1983, but chloride values increased in that period. The highest sodium values were observed in 1976. The analyses showed the soil to be highly variable in

composition, a factor which caused great difficulty in interpreting the data. Therefore, it was not possible to demonstrate a buildup of contaminants in the soil.

A limited amount of injury to vegetation was observed each year in close proximity to the mill. Some of the injury was associated with elevated calcium, sodium or sulphur content, but the relationship between the factors was not clear. The nature of the injury was not extensive and not severe.

A surveillance investigation of snow in the vicinity of the Abitibi Pulp and Paper Company mill in Smooth Rock Falls in 1975 demonstrated the presence of a contamination zone of Ca, Na, SO_4, Cl and Al within a 400 m radius of the paper mill. Snow samples taken in 1976, a strike-year, showed lower concentrations of these chemicals. The pH values recorded in 1976 were considerably lower than those determined in the 1975 collection. This indicates that the paper mill emissions can influence the quality of snow in the area of Smooth Rock Falls.

II. Introduction

A forest products mill complex has been operated by Abitibi-Price Inc. on the Mattagami River at the Town of Smooth Rock Falls since early in this century. Built in 1916 as a sulphite mill, the operation was converted to the kraft process in December, 1965. In 1984 production was 320 tons/day of bleached market kraft pulp and 27 million boardfeet of kiln dried studs.

Atmospheric emissions from mill operations have been identified as total reduced sulphur (TRS), suspended particulates, chlorine and chlorine dioxide.

Under the Environmental Protection Act, the Ministry of the Environment served a Control Order on the mill in 1977 requiring that measures be taken to reduce atmospheric emissions. In an effort to upgrade emissions to the natural environment, several changes were made in production processes from 1978 to 1984. Some improvements in final effluent quality were obtained through the installation of additional or new abatement equipment, and others were made through efficient recycling of process waters. Atmospheric emissions decreased with the installation of particulate reclamation devices, malodourous gas scrubbers and increased combustion efficiency. Some of the pollution control devices installed included a dust collection system on the stud mill in 1974, a dust collector on the refuse boiler in 1976, a

scrubber system on the bleach plant and a recovery furnace in 1978, and an overfire air system on the refuse boiler in 1981. An Amending Control Order to further reduce air emissions was issued in August of 1985.

This report summarizes data obtained from air quality investigations carried out at Smooth Rock Falls from 1974 to 1984.

III. Air Quality Monitoring Programs

The Ontario Ministry of the Environment monitored settleable particulates in the community of Smooth Rock Falls from June, 1977 to July, 1980. Because of the nature of the particulate (large and relatively heavy), dustfall jars were used as monitors. Five dustfall jars were located in the community during that period and were analyzed for total dustfall. Contents of the jars were analysed for calcium from 1978 to 1980 and for sulphates from June, 1977 to 1980 in an attempt to determine the relative contributions from the mill (e.g. calcium and sulphate compounds) to the total dustfall levels.

Total reduced sulphur was monitored at the Municipal Garage in Smooth Rock Falls from October of 1980 to April of 1982. Results of the total reduced sulphur monitoring program are summarized in report NER-AQTM-10-84, released in March, 1984, and are not discussed in this report. This monitoring program resumed in the fall of 1986; the results will be provided separately when the database is larger.

Monitoring Results

Locations of dustfall monitors in Smooth Rock Falls are shown on the attached map (Figure 1). A summary of total dustfall from June, 1977 to July, 1980 is presented in Table 1. Individual summaries for each station are presented in

Tables 2 to 6. The annual mean dustfall levels are presented in graphical forms in Figures 2 to 6 for individual stations.

(i) Total Dustfall

Total dustfall exceeded the Ministry of the Environment's monthly criterion of 7.0 g/m^2/30 days once opposite the Arena (72036), on four occasions east of the Abitibi Mill (72037), three times at Ecole St. Gertrude (72038), and once at Seventh Avenue (72039) (see Table 1) from June, 1977 to August, 1980. The total number of monthly exceedences decreased from four (11% of the samples) in 1977 to zero in 1980.

The yearly mean was above the Provincial criterion of 4.5 g/m^2/30 days in 1979 opposite the Arena (72036). This is a result of one high dustfall level (24.2 g/m^2/30 days) recorded in June of 1979 and may not be typical of settleable particulate levels at that location. The yearly criterion was exceeded in 1977 east of the Abitibi Mill (72037) when three of the seven samples collected that year showed elevated dustfall levels. Contamination from road dust (Ross Road)is suspected to have contributed to these elevated levels. The yearly mean for Station 72037 in 1979, which consisted of only two monthly values, is included but is of limited value.

With the exception of a few elevated monthly values, the average total dustfall levels in Smooth Rock Falls from 1977 to 1980 were not considered high and were generally within

Provincial criteria. The elevated values occurred during "no-snow" cover periods such that vehicular traffic, both at the mill and on public roadways, could have been the major source(s) of particulates. The data do not indicate a clear trend with time and distance from the mill in the average dustfall levels, although at some sites, the values appear to have decreased marginally. On the basis of total dustfall measurements, the impact of particulate emissions from the Abitibi mill on local air quality during the period 1977 to 1980 appears to have been minor.

(ii) Calcium in Dustfall

Results of analysis for calcium in dustfall are presented in Tables 7 to 11. Yearly mean values ranged from 0.05 to 0.18 $g/m^2/30$ days. The Ontario Ministry of the Environment has no criterion for calcium in dustfall; however, the data can assist with source identification and trend analyses. The samples collected in Smooth Rock Falls indicate that calcium in dustfall remained relatively constant during the sample period (1978-80). The sites closest to the mill (72035 and 72036) had annual averages (1979) marginally higher than at the other sites, suggesting a minor impact from the mill.

(iii) Sulphates in Dustfall

Results of analysis for soluble sulphates are presented in Tables 12 to 16. The Ministry has no criterion for sulphate particulate; as with calcium, the data can be useful for

source identification and trend analyses. Soluble sulphates varied somewhat at different sampling locations in the community of Smooth Rock Falls. Yearly mean sulphate values ranged from a high of 1.5 $g/m^2/30$ days at the 7th Avenue site in 1977 to a low of 0.3 $g/m^2/30$ days at the same location in 1980.

In 1978, the annual average at the sites closest to the mill (i.e. 72035 and 72036) were higher than at the other sites by about 0.4 $g/m^2/30$ days of sulphate particulate. In 1979, this differential disappeared, coinciding with the installation of scrubbers on the recovery furnace and the bleach plant. This observation is quite speculative in view of the variability in the data and also since water-soluble sulphate particulates are a component of the long-range transport of air contaminants associated with acid rain. Any impact from the mill on sulphate particulates in dustfall is felt to have been minor.

IV. Vegetation and Soil Sampling Program

(i) Survey Methods

In June, 1974, a preliminary investigation of the Smooth Rock Falls area was undertaken. At this time, five locations were selected for collection of vegetation samples (See Fig. 7). Samples of Trembling Aspen foliage and grass forage were collected for chemical analysis at each location. The samples were subsequently divided into two portions, one of which was water washed to remove any external particulate contaminants. The samples were then analyzed to determine the sulphur, calcium and sodium content of each.

In early September, 1975, the vegetation sampling program was modified to include 7 stations around the paper mill (Figure 8). The collection of samples was also carried out at these same locations in 1976 and 1983. The locations of the sampling stations were as follows:

Station Number	Distance and Direction from the Abitibi Paper Mill
1	325 m NE
2	1300 m NE
3	400 m E
4	900 m E
5	150 m SE
6	550 m W
7	800 m SSE

Triplicate samples of Trembling Aspen foliage and soil (0-10 cm) were collected at each station. The samples were

returned to the laboratory and processed for chemical analysis.

The foliage samples were oven-dried, ground in a Wiley-Mill and bottled. The soil samples were air-dried, ground in a mortar and pestle to pass through a 45-mesh sieve and bottled. The samples were then forwarded to the Ministry's laboratory in Toronto for analysis. The analyses included calcium, sodium, magnesium (soil only in 1975), chloride and sulphur. In 1975, the samples were also analyzed for their iron, copper, lead and zinc content.

(ii) Background Concentration Limits

The Ontario Ministry of the Environment has conducted numerous vegetation and soil sampling programs throughout the Province of Ontario. Based on experience with these programs as well as on data published in the literature, a set of guidelines has been developed to indicate the concentrations of individual chemical elements which are considered to be above background concentration limits for the respective elements. The values of these guidelines were determined by statistically evaluating data for the Northeastern Region using only samples from uncontaminated sites. The values presented in the table below would be encountered no more than once in 100 samples on a statistical basis. Values presented do not necessarily mean that there is toxicity involved, but indicate that there is evidence of contamination above average normal

levels. The concentration limits of elements in vegetation or soil are considered to be tools for use by phytotoxicology investigators in interpreting the results of chemical analyses. Certain limitations exist with these established levels and investigators must judge their use in supplementing other results and observations from field assessment surveys. The following values are used in this report:

Element	Soil	Foliage	Forage
Calcium	3.0%	3.0%	-
Magnesium	1.0%	0.7%	-
Sodium (ppm)	-	50	-
Chloride	-	0.15%	-
Sulphur	0.1%	0.4%	0.5%
Iron (ppm)	3.5%	500	-
Copper (ppm)	60	20	-
Lead (ppm)	150	30	-
Zinc (ppm)	500	-	-

(iii) Analytical Results

The analytical results of the 1974 collection of vegetation are shown in Tables 17 and 18. The concentrations of sulphur were within the normal range for these species. The washing procedure showed essentially no effect on the sulphur content of the samples.

The calcium content of vegetation was within the normal concentration range for all samples. The washing procedure reduced the calcium values in all samples except in forage at Site 2, where both washed and unwashed portions contained similar amounts. Washing apparently removed surface deposits

containing calcium from the foliage. There was an evident pattern with higher concentrations being measured nearest the kraft mill.

Sodium values in all samples exceeded the Background Concentration Limit of 50 ug/g Na. Washing of the samples reduced the sodium content at Sites 1 (Aspen only), 2, 3 and 5. The elevated sodium values did not show any relationship to distance and direction from the kraft mill.

The results of the chemical analyses conducted in 1975 to 1983 are presented in Tables 19 to 23. The calcium values in aspen collected at Sites 1, 3 and 6 in 1975 and Sites 2 and 6 in 1976 exceeded the Background Concentration Limit of 3%. The concentrations of calcium decreased by approximately half at all locations in 1983. It was not possible to demonstrate any pattern of elevated calcium values that might be related to the position of the kraft mill. The calcium concentrations in the soil showed extremely high variability from year to year. The Background Concentration Limit of 3% calcium in soil was exceeded at five stations in one or two collections. These high values of calcium in the soil are probably more indicative of the highly calcareous nature of the soils in this region than of emissions from the mill.

At least one collection of Trembling Aspen foliage at each station contained sodium concentrations in excess of the Background Concentration Limit (Table 20). Samples from

Stations 1 and 3 exceeded this Limit in all three collections. The highest sodium concentration was encountered at Site 5 in 1976 where injury to the foliage had been noted (see below). All foliage samples contained higher concentrations in 1976 than in 1975, but the values decreased in 1983.

The magnesium content of the foliage samples was normal in all collections (Table 21). The values for magnesium in soil were extremely variable, but high values corresponded with high values of calcium measured in the same sample. One or two collections at five locations exceeded the Background Concentration Limit. Elevated levels of magnesium in the soil showed no correlation to location of the kraft mill.

At least one collection of Trembling Aspen foliage at each sampling station contained chloride in excess of the Background Concentration Limit of 0.15% chloride (Table 22). This Limit was exceeded at all locations for which data were available in 1983, and concentrations increased compared with preceding years. Chloride concentrations in the soil were all very low (below detection limit at all locations in 1976).

The sulphur content of the samples of aspen foliage were all within the normal concentration range (Table 23). No significant changes from year to year or patterns in concentrations that might be due to emissions from the paper mill were noted. Two soil collections (Site 3 in 1976 and Site 4 in 1983) contained sulphur in concentrations slightly in excess of

Background Concentration Limits, but these were not related to possible kraft mill emissions.

All concentrations of iron, copper, lead and zinc were within the normal concentration ranges for all soil and vegetation samples (Table 24).

(iv) Injury to Vegetation

At the time of the collection of samples in the summers of 1974, 1975, 1976 and 1983, observations were made on the condition of vegetation growing in the vicinity of the sampling locations. Assessments were made of injuries due to air contaminants, insects or disease and the presence of particulate material on the surface of the foliage.

The most commonly occurring species was Trembling Aspen, and the injury data associated with this species is summarized in Table 25. In June, 1974, a survey of the Town indicated the presence of a white crystalline material on the surface of foliage of trees growing in the area south of the mill. The amount of material decreased with distance from the mill. Nowhere was the material found to be excessive nor could any injury be ascribed to its presence. Analysis of forage samples suggested that the material contained calcium.

In 1975, light injury from fungal leaf spotting and insect was common throughout the area. At site 3, light marginal

necrosis was encountered which corresponded with elevated concentrations of calcium and sulphur content of the foliage. A light overall chlorosis of the foliage was noted at Site 1, where elevated calcium values were also noted.

In July, 1976, fibrous particulate (believed to be fine material from the nearby chip piles) and white particulate were noted at Site 3. Trace amounts of white particulate were also noted at Site 4. In both July and August of 1976 at Site 5 and in August at Sites 1 and 7, injury in the form of necrosis of the foliar tissues of aspen were seen. Samples of these tissues contained elevated sodium and sulphur. Insect injury was also common in 1976.

The only unusual injury seen in 1983 occurred at Site 5 where some of the higher chloride values were also measured.

V. Snow Sampling Study

(i) Survey Methods

The first collection of snow samples was made on January 15, 1975, at a total of 21 locations along radii to the east, southeast, southwest, northwest and north up to 1600 km from the paper mill. The number of sample collection locations around the mill was increased to 23 on February 4, 1975. Snow was collected at a single control site 8 km west of Smooth Rock Falls. The locations of the sample sites are shown in Figure 9.

At each sample location, five circular cores of snow (18 cm deep and 8 cm in diameter) were collected and allowed to melt overnight at room temperature. The five snow melt water samples were then combined and a pH measurement taken immediately. Each sample was then divided into two equal portions, and one of these portions was preserved by the addition of 2 ml of nitric acid. The acidified portion of the sample was analyzed for Ca, Na and Al, while the sulphate and chloride concentrations were determined from the non-acidified portion.

In 1976, a single collection of snow samples was made on January 14. Samples were collected at ten locations in the vicinity of the paper mill, corresponding to several collection sites established in 1975. These locations are indicated in Figure 10. In addition, a control sample was taken 8 km west of Smooth Rock Falls. Since the mill was not operational in 1976 due to a labour strike, it was considered that a comparison between the two years could indicate the degree of contamination of the area.

At each sample location, duplicate samples of snow were collected. The samples consisted of circular cores of snow, 7.5 cm in diameter, and represented a complete profile of the snow from the surface to the ground level. The sample was taken in such a manner as to avoid contamination by ground materials. The number of cores required to fill 4.5 kg polyethylene bags was recorded. The samples were returned to the

laboratory and allowed to melt overnight at room temperature in the polyethylene bags. The volume of snow melt water was measured and a pH measurement taken immediately. The sample was analyzed for SO_4, Ca, Na, Cl and Fe concentrations.

At the time of sampling, the total depth of snow was recorded, as well as the depth of fresh snow and the number of crust layers. Notes were made on the number and type of any banding or layering in the snow profile. The presence of black precipitate in the meltwater, or of scum on the water surface, was noted and rated on an arbitrary scale of none to heavy.

(ii) Background Concentration Limits

Background Concentration Limits for elements in snow have been established in the same manner as those for soil and vegetation, as described earlier in this report. The values which relate to this report are as follows:

Element	Background Concentration Limit (mg/L)
Sulphate	3
Chloride	4
Calcium	2
Sodium	2
Aluminum	0.6
Iron	0.7

(iii) Analytical Results

The condition and depth observations made on the snow samples are presented in Table 26, and the analytical results of the snow samples for both years are summarized in Table 27. Snow depths ranged from 30 to 51 cm with no indication of particu-

late banding in the snow profile. No surface scum was observed in any sample, and a light precipitate was observed in only one sample (Station 1).

Sulphate concentrations in the snow exceeded the Background Concentration Limit of 3.0 mg/L at all sites except Sites 13, 16 and 20 in January, 1975 (Table 27). With the exception perhaps of Site 20, the sulphate value decreased with increasing distance from the mill. In February, the sulphate concentrations tended to decrease, especially in samples collected south and west of the mill. The number of sites which exceeded the Background Concentration Limit for sulphate was reduced to 12 in February. The values reported for the 1976 collection contrast sharply with those of the previous year, being significantly lower at all locations.

In 1975, chloride values exceeded the Background Concentration Limit of 2 mg/L Cl at Sites 5 and 20 in January and at Sites 1 and 5 in February. These sites are all located within 200 m of the mill. In 1976 only, the sample from Site 10 exceeded the Background Concentration Limit for both chloride and sodium, indicating that road salt may have been a local contaminant at this location.

The calcium concentrations exceeded the Background Concentration Limit at 13 sites in January, 1975 and at seven sites in February, 1975. The distribution patterns were generally highest in close proximity to the mill and decreased

with distance from it. The values measured in 1976 decreased substantially from the preceding year.

In January, 1975, the sample collected at Site 16 was the only one which did not exceed the Background Concentration Limit for sodium. The sodium concentrations decreased somewhat in February, 1975, at most locations; however, the distribution patterns indicated that the mill was the source of this element. Sodium concentrations were low in all collections in 1976, except at Site 10 where some road salt may have been involved, as noted above.

The concentrations of aluminum exceeded the Background Concentration Limit at Sites 1, 5, 20 and 24. The first three are all in close proximity to the mill; however, there is no known source of aluminum at the latter location, which is the control site.

Values obtained in 1976 are all below the Background Concentration Limit for iron. The pH values decreased in 1976 compared with 1975, indicating that there is less particulate material in the snow in 1976.

APPENDIX

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Dustfall Monitoring

Dustfall (total) comprises of larger, more visible, particulate matter which settles out from the atmosphere by gravity. It is measured by exposing an open top plastic jar for approximately 30 days.

The total amount of dustfall is determined by weighing the contents of the jar and expressing the results in $g/m^2/30$ days.

The settleable particulate collected in the dustfall jar can be separated into a soluble and an insoluble fraction for further analysis. The insoluble portion can be examined using an optical microscope to determine the composition of the particulate.

Although this method of sampling can be variable and is dependant on external factors such as wind and the amount of rain and/or snowfall during the sampling period, it is very useful in determining the amount of settleable particulate in the atmosphere.

TABLE 1

ANNUAL SUMMARY OF TOTAL DUSTFALL DATA COLLECTED IN SMOOTH ROCK FALLS FROM JUNE, 1977 TO AUGUST,1980

LOCATION	NUMBER OF SAMPLES				ARITHMETIC MEAN (g/m^2/30 days)				MAXIMUM VALUE (g/m^2/30 days)				NO. OF SAMPLES ABOVE PROVINCIAL CRITERION			
	1977	1978	1979	1980	1977	1978	1979	1980	1977	1978	1979	1980	1977	1978	1979	1980
Opposite Hospital Second Avenue (72035)	7	12	12	7	2.6	2.3	2.9	3.2	4.8	6.0	6.0	5.5	0	0	0	0
Opposite Arena Fourth Street (72036)	7	12	12	7	3.9	4.0	5.6	3.8	6.7	6.1	24.2	5.9	0	0	1	0
East of Abitibi Paper (72037)	7	11	2	0	9.5	3.3	0.8	-	30.3	10.8	0.8	-	3	1	0	-
Ecole Ste. Gertrude (72038)	7	11	12	7	3.8	2.6	3.0	3.5	8.7	7.1	9.6	7.0	1	1	1	0
75th Avenue Crescent (72039)	7	12	12	7	2.6	3.3	1.8	3.5	5.0	10.9	2.9	6.0	0	1	0	0
TOTAL	35	58	50	28									4	3	2	0

Provincial Criterion - 7.0 g/m^2/30 days (30 day period)
4.2 g/m^2/yearly mean

TABLE 2

TOTAL DUSTFAL LEVELS OPPOSITE HOSPITAL,
STATION 72035, IN SMOOTH ROCK FALLS
FROM 1977 TO 1980
(g/m^2/30 days)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	MEAN
1977	--	--	--	--	--	2.9	3.5	3.4	4.8	1.5	1.3	0.9	2.6
1978	0.7	2.1	2.0	0.1	6.0	4.2	2.0	1.5	3.5	3.2	1.2	1.1	2.3
1979	1.5	1.1	3.2	4.8	6.0	4.7	2.2	2.2	3.4	2.0	2.0	1.3	2.9
1980	1.0	2.8	3.6	3.5	5.5	2.9	2.9	DISCONTINUED AUGUST, 1980					3.2

NOTE: -- Indicates missing or invalid data

PROVINCIAL CRITERION: Monthly - 7.0 g/m^2/30 days
Yearly - 4.6 g/m^2/30 days
Underlined values exceed Provincial Criterion

TABLE 3

TOTAL DUSTFALL LEVELS OPPOSITE ARENA,
STATION 72036 IN SMOOTH ROCK FALLS
FROM 1977 TO 1980
(g/m^2/3 days)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	MEAN
1977	--	--	--	--	--	1.5	5.5	4.9	6.7	3.9	2.5	2.6	3.9
1978	6.1	5.5	4.2	0.1	4.9	4.7	3.5	3.3	4.8	5.0	3.0	2.9	4.0
1979	4.9	2.5	3.9	5.3	5.0	24.2	3.4	3.0	5.0	3.2	3.2	3.7	5.6
1980	5.9	3.9	2.6	3.9	3.7	3.4	3.4	DISCONTINUED AUGUST, 1980					3.8

NOTE: -- Indicates missing or invalid data

PROVINCIAL CRITERION: Monthly - 7.0 g/m^2/30 days
Yearly - 4.6 g/m^2/30 days
Underlined values exceed Provincial Criterion

TABLE 4

TOTAL DUSTFALL LEVELS EAST OF ABITIBI MILL,
STATION 72037, IN SMOOTH ROCK FALLS
FROM 1977 TO 1979
(g/m^2/30 days)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	MEAN
1977	--	--	--	--	--	11.5	30.3	4.7	2.6	12.2	3.4	1.7	9.5
1978	1.4	2.9	2.9	4.7	--	10.8	6.9	2.0	1.8	1.3	1.3	0.6	3.3
1979	0.8	0.8	--	STATION DISCONTINUED FEBRUARY 1979						--	--	--	0.8

NOTE: -- Indicates missing or invalid data

PROVINCIAL CRITERION: Monthly - 7.0 g/m^2/30 days
Yearly - 4.6 g/m^2/30 days
Underlined values exceed Provincial Criterion

TABLE 5

TOTAL DUSTFALL LEVELS ECOLE STE. GERTRUDE,
STATION 72038, SMOOTH ROCK FALLS
FROM 1977 TO 1980
(g/m^2/30 days)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	MEAN
1977	--	--	--	--	--	3.4	4.7	2.4	8.7	2.3	2.2	3.0	3.8
1978	1.2	2.1	1.5	5.3	--	3.3	7.1	1.6	1.9	2.5	1.0	0.7	2.6
1979	1.1	0.4	1.3	2.1	6.1	4.1	9.6	2.3	3.3	2.1	2.1	1.2	3.0
1980	2.5	2.5	1.7	2.7	7.0	3.9	3.9	DISCONTINUED AUGUST, 1980					3.5

NOTE: -- Indicates missing or invalid data

PROVINCIAL CRITERION: Monthly - 7.0 g/m^2/30 days
Yearly - 4.6 g/m^2/30 days
Underlined values exceed Provincial Criterion

TABLE 6

TOTAL DUSTFALL LEVELS 7th AVENUE CRESCENT,
STATION 72039, IN SMOOTH ROCK FALLS
FROM 1977 TO 1980
(g/m^2/30 days)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	MEAN
1977	--	--	--	--	--	3.1	5.0	1.3	4.4	2.5	1.0	1.2	2.6
1978	5.1	1.4	1.7	4.5	2.9	3.7	10.9	0.8	0.9	4.7	2.2	0.4	3.3
1979	1.1	1.2	1.2	2.9	2.5	2.6	2.0	2.0	2.7	1.2	1.2	0.8	1.8
1980	1.3	1.7	3.0	2.3	3.9	6.0	6.0	DISCONTINUED AUGUST, 1980					3.5

NOTE: -- Indicates missing or invalid data

PROVINCIAL CRITERION: Monthly - 7.0 g/m^2/30 days
Yearly - 4.6 g/m^2/30 days
Underlined values exceed Provincial Criterion

TABLE 7

CALCIUM IN DUSTFALL COLLECTED OPPOSITE HOSPITAL, SECOND AVENUE,
STATION 72035 SMOOTH ROCK FALLS
FROM 1978 to 1980
(g/m^2/30 days)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	MEAN
1978	0	0.01	0.06	--	--	--	--	0.02	0.12	0.09	0.04	0.02	0.05
1979	0.06	0.03	0.20	--	0.19	0.11	0.10	0.06	0.13	0.14	0.14	--	0.12
1980	0.05	0.11	--	0.15	0.34	0.06	--	DISCONTINUED AUGUST 1980					0.14

TABLE 8

CALCIUM IN DUSTFALL COLLECTED OPPOSITE ARENA, FOURTH STREET
STATION 72036 SMOOTH ROCK FALLS
FROM 1978 TO 1980
(g/m^2/30 days)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	MEAN
1978	0	0.02	0.10	--	--	--	0.09	0.09	0.27	0.15	0.07	0.09	0.10
1979	0.08	0.03	0.18	0.21	0.20	0.21	0.12	0.10	0.21	0.10	0.10	--	0.14
1980	0.16	0.12	0.23	0.16	0.18	0.06	--	--	DISCONTINUED AUGUST 1980				0.15

NOTE: -- Indicates missing or invalid data
No Provincial Criterion

TABLE 9

CALCIUM IN DUSTFALL COLLECTED EAST OF ABITIBI PAPER
STATION 72037 SMOOTH ROCK FALLS
FROM 1978 TO 1979
(g/m^2/30 days)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	MEAN
1978	0	0.02	0.06	--	--	--	0.08	--	--	0.10	0.04	0.02	0.05
1979	0.02	0.03	--	--	--	--	--	--	--	--	--	--	0.03

TABLE 10

CALCIUM IN DUSTFALL COLLECTED AT ECOLE STE. GERTRUDE,
STATION 72038 SMOOTH ROCK FALLS
FROM 1978 TO 1980
(g/m^2/30 days)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	MEAN
1978	0	.02	.09	--	--	--	.03	.04	.07	.57	.04	.02	.10
1979	.11	.02	.08	.08	.20	.09	.14	.07	.11	.07	.07	--	.09
1980	.08	.09	.15	.10	.62	.05	--	DISCONTINUED AUGUST 1980					.18

NOTE: -- Indicates missing or invalid data
No Provincial Criterion

TABLE 11

CALCIUM IN DUSTFALL COLLECTED AT 7TH AVENUE CRESCENT
STATION 72039 SMOOTH ROCK FALLS
FROM 1978 TO 1980
(g/m^2/30 days)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	MEAN
1978	0	0.01	0.04	--	--	--	--	0.04	--	0.51	0.08	0.02	0.09
1979	0	0.03	0.06	--	--	0.19	0.06	0.08	0.07	0.04	0.04	--	0.06
1980	0.05	0.09	0.19	0.10	0.17	0.05	--	DISCONTINUED AUGUST 1980					0.10

NOTE: -- indicates missing or invalid data
No Provincial Criterion

TABLE 12

SOLUBLE SULPHATES IN DUSTFALL OPPOSITE HOSPITAL, SECOND AVENUE,
STATION 72035 SMOOTH ROCK FALLS
FROM 1977 TO 1980
(g/m^2/30 days)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	MEAN
1977	--	--	--	--	--	0.8	0.8	0.7	2.8	0.3	0.8	0.2	0.9
1978	0.5	0.7	0.6	--	2.5	0.8	0.5	--	0.8	0.6	1.9	0.1	0.9
1979	0.4	0.1	0.9	0.7	0.8	0.4	0.5	0.7	0.7	0.3	0.3	--	0.5
1980	0.2	0.5	--	0.4	1.0	0.2	--	DISCONTINUED AUGUST 1980					0.5

TABLE 13

SOLUBLE SULPHATES IN DUSTFALL OPPOSITE ARENA, FOURTH STREET
STATION 72036 SMOOTH ROCK FALLS
FROM 1977 TO 1980
(g/m^2/30 days)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	MEAN
1977	--	--	--	--	--	0.1	1.3	1.5	3.1	1.0	1.1	0.2	0.2
1978	0.2	0.9	--	--	1.8	1.3	0.5	0.8	0.7	1.9	0.4	0.5	0.9
1979	0.4	0.1	0.6	0.8	0.7	0.6	0.4	0.8	1.4	0.5	0.5	--	0.6
1980	0.7	0.7	0.8	0.6	0.5	0.2	--	DISCONTINUED AUGUST 1980					0.6

NOTE: -- Indicates missing or invalid data
No Provincial Criterion

TABLE 14

SOLUBLE SULPHATES IN DUSTFALL EAST OF ABITIBI PAPER,
STATION 72037 SMOOTH ROCK FALLS
FROM 1977 TO 1978
(g/m^2/30 days)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	MEAN
1977	--	--	--	--	--	1.0	--	1.7	0.6	1.1	0.4	0.1	0.8
1978	0.1	0.9	0.3	--	--	1.0	0.5	--	0.5	--	0.2	0.2	0.5

TABLE 15

SOLUBLE SULPHATES IN DUSTFALL AT ECOLE STE. GERTRUDE,
STATION 72038 SMOOTH ROCK FALLS
FROM 1977 TO 1980
(g/m^2/30 days)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	MEAN
1977	--	--	--	--	--	0.7	0.8	0.4	2.4	0.5	0.7	1.1	0.9
1978	0.1	0.7	0.3	--	1.1	0.6	0.3	0.4	0.5	1.2	0.4	0.2	0.5
1979	0.3	0.1	0.4	0.6	0.7	0.4	0.7	0.7	0.8	0.3	0.3	--	0.5
1980	0.6	0.4	0.6	0.4	0.4	0.3	--	DISCONTINUED AUGUST 1980					0.4

NOTE: -- Indicates missing or invalid data
No Provincial Criterion

TABLE 16

SOLUBLE SULPHATES IN DUSTFALL AT 7TH AVENUE CRESCENT
STATION 72039 SMOOTH ROCK FALLS
FROM 1977 TO 1980
(g/m^2/30 days)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	MEAN
1977	--	--	--	--	--	0.7	0.8	0.3	1.1	6.2	0.4	1.0	1.5
1978	0.2	0.5	0.3	--	1.3	0.6	0.6	--	--	1.0	0.3	0.1	0.5
1979	0.3	0.3	0.3	0.7	--	0.8	0.5	0.6	0.6	0.2	0.2	--	0.5
1980	0.2	0.4	0.7	0.2	0.3	0.2	0.2	DISCONTINUED AUGUST 1980					0.3

NOTE: -- Indicates missing or invalid data
No Provincial Criterion

TABLE 17

CONCENTRATIONS OF VARIOUS CHEMICALS IN TREMBLING ASPEN

IN THE SMOOTH ROCK FALLS AREA

1974

Location*		S%		Ca ppm		Na ppm	
		Washed	Not Washed	Washed	Not Washed	Washed	Not Washed
1	300 m S	.25	.25	1550	1750	470	500
2	700 m S	.21	.21	2280	3200	400	430
3	400 m SE	.23	.23	2520	2640	320	350
4	500 m E	.24	.24	2170	2200	300	300
5	800 m SE	.28	.28	2600	3440	810	820

* Distance and direction from Abitibi Pulp and Paper Mill

TABLE 18

CONCENTRATIONS OF VARIOUS CHEMICALS IN FORAGE

COLLECTED IN THE SMOOTH ROCK FALLS AREA

1974

Location*	S%		Ca ppm		Na ppm	
	Washed	Not Washed	Washed	Not Washed	Washed	Not Washed
1 300 m S	.22	.25	730	1000	400	320
2 700 m S	.20	.20	650	650	470	510
3 400 m SE	.24	.24	690	750	210	270
4 500 m E	.25	.26	610	680	280	280
5 800 m SE	.23	.23	510	580	370	460

* Distance and direction from Abitibi Pulp and Paper Mill

TABLE 19

CONCENTRATIONS OF CALCIUM (%) IN TREMBLING ASPEN

FOLIAGE AND SOIL

IN THE VICINITY OF SMOOTH ROCK FALLS

SITE	VEGETATION			SOIL		
	1975	1976	1983	1975	1976	1983
1	3.7	2.2	1.29	0.30	4.11	0.20
2	2.0	3.3	1.03	2.66	10.7	1.37
3	4.3	2.8	1.68	8.83	0.74	5.90
4	2.45	2.9	1.49	7.29	0.90	3.26
5	1.56	1.8	0.75	4.75	9.58	1.40
6	3.02	3.5	1.39	0.57	0.69	0.79
7	1.88	2.0	1.00	0.76	0.43	0.58

TABLE 20

CONCENTRATIONS OF SODIUM (ug/g) IN TREMBLING ASPEN FOLIAGE AND SOIL IN THE VICINITY OF SMOOTH ROCK FALLS

SITE	VEGETATION			SOIL		
	1975	1976	1983	1975	1976	1983
1	57	237	130	130	223	58
2	23	56	30	200	147	110
3	63	513	193	205	273	273
4	55	320	43	178	143	193
5	50	2100	30	166	220	197
6	32	45	110	203	153	160
7	168	497	33	191	107	147

TABLE 21

CONCENTRATIONS OF MAGNESIUM (%) IN TREMBLING ASPEN

FOLIAGE AND SOIL

IN THE VICINITY OF SMOOTH ROCK FALLS

SITE	VEGETATION		SOIL		
	1976	1983	1975	1976	1983
1	0.26	0.26	0.29	1.23	0.15
2	0.31	0.29	1.68	1.61	0.55
3	0.20	0.18	2.59	0.76	2.07
4	0.30	0.25	2.40	0.69	1.17
5	0.16	0.15	1.97	1.54	0.81
6	0.25	0.27	0.73	0.74	0.72
7	0.26	0.27	0.31	0.39	0.62

TABLE 22

CONCENTRATIONS OF CHLORIDE (%) IN TREMBLING ASPEN FOLIAGE AND SOIL IN THE VICINITY OF SMOOTH ROCK FALLS

SITE	VEGETATION			SOIL		
	1975	1976	1983	1975	1976	1983
1	.14	.13	.20	.02	<.02	.03
2	.06	.10	.22	.02	<.02	.02
3	.15	.22	.32	.03	<.02	.04
4	.18	.32	-	.03	<.02	.01
5	.23	.19	.31	.03	<.02	.01
6	.11	.11	.16	.02	<.02	.01
7	.16	.13	.18	<.02	<.02	.01

TABLE 23

CONCENTRATIONS OF SULPHUR (%) IN TREMBLING ASPEN

FOLIAGE AND SOIL

IN THE VICINITY OF SMOOTH ROCK FALLS

SITE	VEGETATION			SOIL		
	1975	1976	1983	1975	1976	1983
1	.15	.16	.23	.04	.02	.02
2	.17	.16	.16	.03	.01	.07
3	.31	.20	.13	.08	.12	.02
4	.17	.23	.21	.05	.02	.11
5	.15	.24	.19	.04	.06	.04
6	.17	.18	.16	.04	.02	.03
7	.15	.23	.23	.04	.03	.04

TABLE 24

CONCENTRATIONS (ug/g) OF SEVERAL CHEMICAL ELEMENTS

IN TREMBLING ASPEN FOLIAGE AND SOIL (0-10 cm) COLLECTED

IN THE VICINITY OF SMOOTH ROCK FALLS IN 1975

	VEGETATION				SOIL			
SITE	IRON	COPPER	LEAD	ZINC	IRON(%)	COPPER	LEAD	ZINC
1	43	4	10	182	1.01	6	35	56
2	39	5	11	218	2.43	29	43	79
3	174	4	13	164	1.68	34	107	80
4	71	6	14	266	1.57	19	33	79
5	38	7	9	215	1.71	26	54	73
6	45	5	13	256	2.21	18	41	76
7	42	5	15	165	1.82	21	34	79

TABLE 25 SUMMARY OF INJURY TO FOLIAGE OF TREMBLING ASPEN

OBSERVED IN THE TOWN OF SMOOTH ROCK FALLS

1975 to 1983

PLOT NO.	OBSERVATION DATE				
	June 25, 1974	September 10, 1975	July 21, 1976	August 26, 1976	August 16, 1983
1		slight overall chlorosis, light fungal leaf spot	-	light to moderate black intercostal necrosis, overall chlorosis, trace white particulate	-
2		light fungal leaf spot	-	light insect injuries	-
3	trace to light white particulate	senescence and light marginal necrosis and anthrocyanosis	fibrous (wood chips) and white particulate	severe insect injuries abundant fibrous (wood chip) on foliage	-
4	no white material	light insect injury	trace white particulate on leaves	trace of particulate on foliage	-
5	white powder on all plant species	light fungal leaf spot, light insect injury	moderate intercostal chlorosis with necrotic spotting of intercostal areas	light black necrosis of margin, light intercostal lesions and overall chlorosis	light intercostal necrotic spotting
6	extensive insect injury	light fungal leaf spot, light insect injury	-	light insect injury	-
7	trace white powder	light fungal leaf spot, light insect injury	-	light insect injury light intercostal necrosis	-

TABLE 26

CONDITION AND DEPTH OF SNOW AT SA[illegible]NG LOCATIONS

IN THE SMOOTH ROCK FALLS AREA, 1976

Station	Total Depth (cm)	# of Crust Layers	Banding in Profile	Precipitate	Melt-Water Surface Scum
1	37	1	None	Light	-
2	48	-	None	-	-
3	30	-	None	-	-
5	36	-	None	-	-
6	43	-	None	-	-
7	51	-	None	-	-
9	39	-	None	-	-
10	50	-	None	-	-
15	34	-	None	-	-
20	37	-	None	-	-
24 (Control)	48	-	None	-	-

TABLE 27

CONCENTRATIONS (ug/g) OF THE VARIOUS CHEMICAL ELEMENTS IN SNOW MELT WATER
COLLECTED IN THE SMOOTH ROCK FALLS AREA - 1975

LOCATION *	Sulphate			Chloride			Calcium			Sodium			Aluminum	Iron	pH	
	JAN. 1975	FEB. 1975	JAN. 1976	JAN. 1975	FEB. 1975	JAN. 1976	JAN. 1975	FEB. 1975	JAN. 1976	JAN. 1975	FEB. 1975	JAN. 1976	FEB. 1975	JAN. 1976	JAN. 1975	JAN. 1976
1 200 m E	30.0	32.0	1.0	2.4	4.4	0.4	11.0	15.0	0.5	16.0	21.0	0.1	2.50	0.1	5.65	5.05
2 400 m E	15.0	8.6	0.9	3.9	1.2	0.1	2.4	1.6	0.7	9.6	5.7	0.1	0.23	0.3	5.60	4.70
3 800 m E	13.0	11.0	0.9	2.1	1.3	1.3	0.8	1.3	0.2	7.9	6.7	0.4	0.20	0.1	6.05	4.79
4 1600 m E	11.0	6.0	---	0.58	1.5	---	1.3	0.6	---	5.5	3.7	---	0.33	---	6.30	----
5 200 m SE	50.0	6.2	1.0	4.4	13.0	0.5	9.3	4.4	0.5	27.0	8.4	0.1	0.94	0.3	5.85	4.91
6 400 m SE	15.0	9.4	0.9	0.58	0.9	0.1	4.8	2.1	0.2	7.8	5.7	0.2	0.58	0.1	5.95	4.66
7 800 m SE	11.0	4.1	0.9	0.76	0.7	1.3	4.9	1.0	0.5	5.6	3.3	0.7	0.18	0.3	6.00	4.99
8 1600 m SE	7.1	1.1	---	0.58	0.4	---	2.3	0.3	---	3.9	0.96	---	0.15	---	6.10	----
9 200 m S	----	1.9	0.4	---	0.9	0.5	---	3.0	0.1	---	1.7	0.1	0.06	0.1	----	4.70
10 400 m S	13.0	1.1	0.6	1.7	0.5	3.7	4.2	0.6	0.5	8.1	1.0	2.2	0.07	0.1	5.80	4.80
11 800 m S	6.2	1.0	---	2.8	1.8	---	1.0	0.55	---	5.4	1.8	---	0.39	---	5.90	----
12 1200 m S	10.0	----	---	1.2	---	---	2.5	---	---	6.1	---	---	----	---	5.90	----
13 1600 m S	3.0	0.9	---	1.7	2.0	---	1.0	0.40	---	2.3	1.8	---	0.18	---	6.20	----
14 200 m W	6.0	7.6	---	0.42	1.1	---	1.4	2.8	---	3.4	4.4	---	0.23	---	5.70	----
15 400 m W	6.1	2.2	0.5	0.94	1.4	1.3	1.0	0.75	0.4	3.2	1.6	0.1	0.15	0.6	5.85	4.77
16 800 m W	2.1	----	---	1.4	---	---	7.4	---	---	1.7	---	---	----	---	5.90	----
17 200 m NW	22.0	1.5	---	0.88	0.6	---	5.0	0.40	---	11.0	0.84	---	0.21	---	5.90	----
18 400 m NW	48.0	1.8	---	1.6	2.1	---	2.8	0.65	---	24.0	2.3	---	0.36	---	5.95	----
19 800 m NW	14.0	6.9	---	0.56	1.7	---	2.2	0.65	---	6.5	4.8	---	0.23	---	5.95	----
20 200 m N	2.5	9.4	0.6	7.5	1.7	0.3	13.0	20.0	0.7	5.3	5.2	0.1	0.61	0.2	----	5.20
21 400 m N	----	5.7	---	---	0.9	---	---	8.2	---	---	2.8	---	0.44	---	----	----
22 800 m N	15.0	7.7	---	0.9	1.3	---	1.3	1.5	---	8.3	4.5	---	0.08	---	6.00	----
23 1600 m N	11.0	6.6	---	1.1	1.3	---	1.7	0.6	---	5.7	4.3	---	0.08	---	6.00	----
24 8 km W (Control)	----	0.6	0.6	---	1.4	1.9	---	0.25	0.2	---	0.96	0.7	1.04	0.2	----	4.89

* Distance and Direction from the Abitibi Pulp & Paper Mill

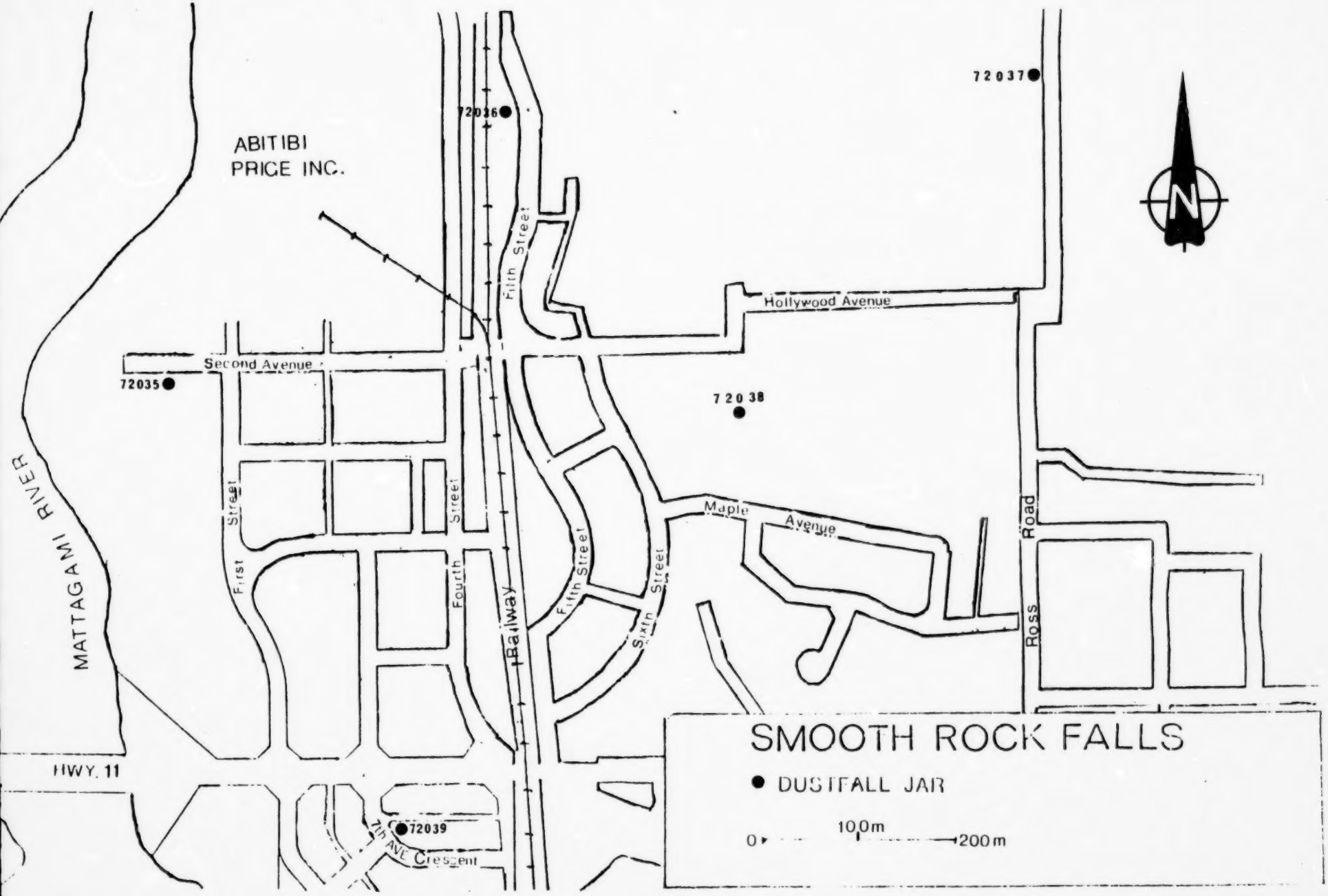

ABITIBI
PRICE INC.
72037
72036
72035
72038
72039
Hollywood Avenue
Second Avenue
Fifth Street
First Street
Fourth Street
Railway
Maple Avenue
Sixth Street
Ross Road
MATTAGAMI RIVER
HWY. 11
7th AVE Crescent
N
SMOOTH ROCK FALLS
DUSTFALL JAR
0
100m
200m

Fig. 1

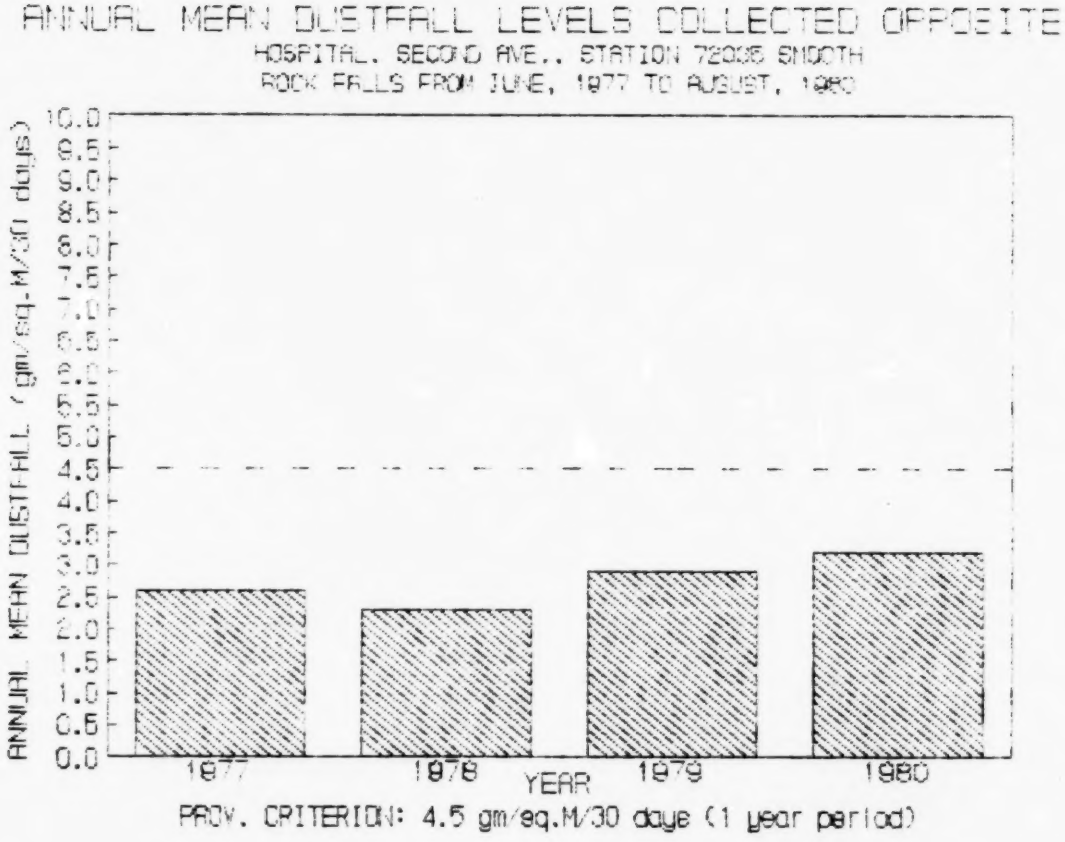

ANNUAL MEAN DUSTFALL LEVELS COLLECTED OPPOSITE
HOSPITAL, SECOND AVE., STATION 72038 SMOOTH
ROCK FALLS FROM JUNE, 1977 TO AUGUST, 1980
ANNUAL MEAN DUSTFALL (gm/sq.M/30 days)
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1977
1978
1979
1980
YEAR
PROV. CRITERION: 4.5 gm/sq.M/30 days (1 year period)

Figure 2

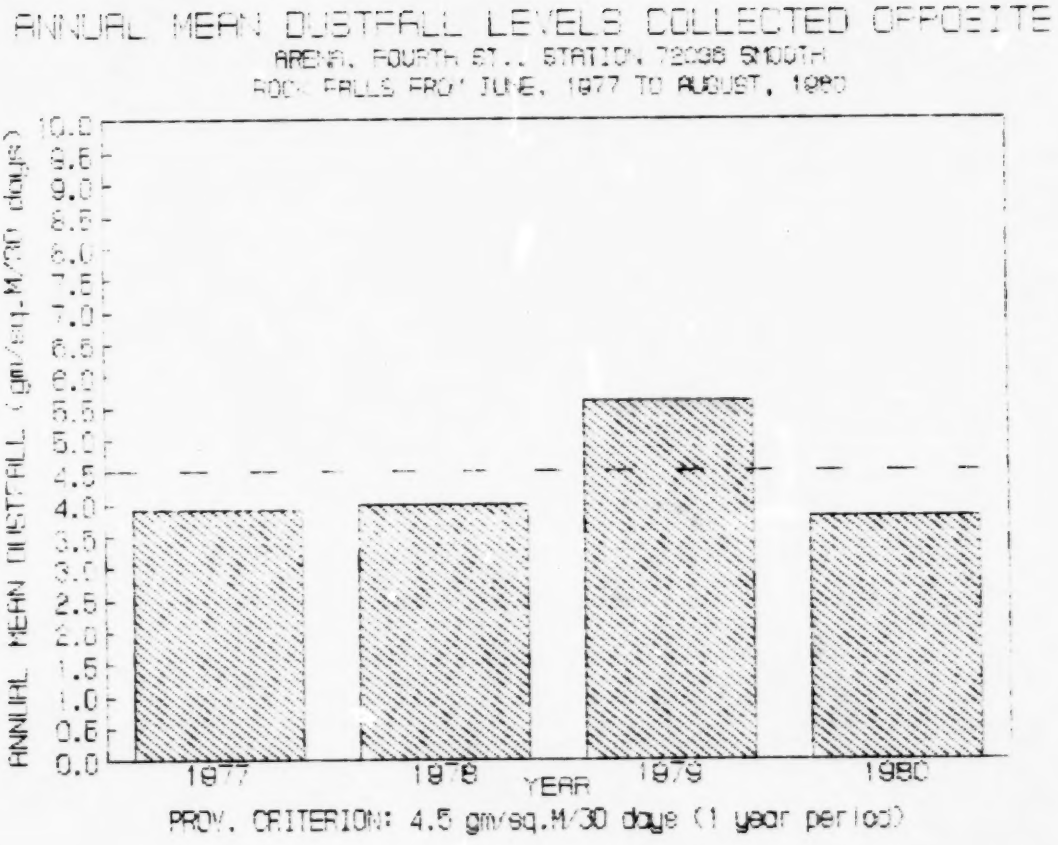

ANNUAL MEAN DUSTFALL LEVELS COLLECTED OFFSITE
ARENA, FOURTH ST., STATION 72038 SMOOTH
ROCK FALLS PROV JUNE, 1977 TO AUGUST, 1980
ANNUAL MEAN DUSTFALL (gm/sq.M/30 days)
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1977
1978
1979
1980
YEAR
PROV. CRITERION: 4.5 gm/sq.M/30 days (1 year period)

Figure 3

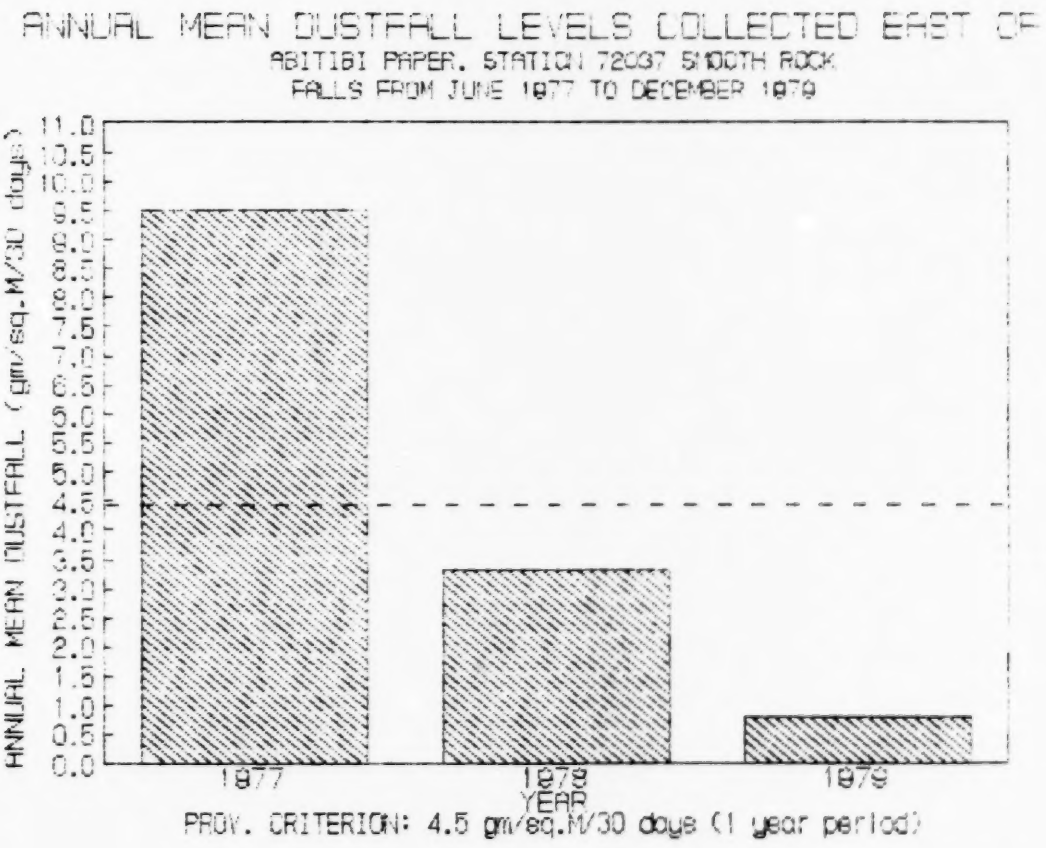

ANNUAL MEAN DUSTFALL LEVELS COLLECTED EAST OF
ABITIBI PAPER. STATION 72037 SNOOTH ROCK
FALLS FROM JUNE 1977 TO DECEMBER 1979
ANNUAL MEAN DUSTFALL (gm/sq.M/30 days)
11.0
10.5
10.0
4.5
0.0
1977
1978
1979
YEAR
PROV. CRITERION: 4.5 gm/sq.M/30 days (1 year period)

Figure 4

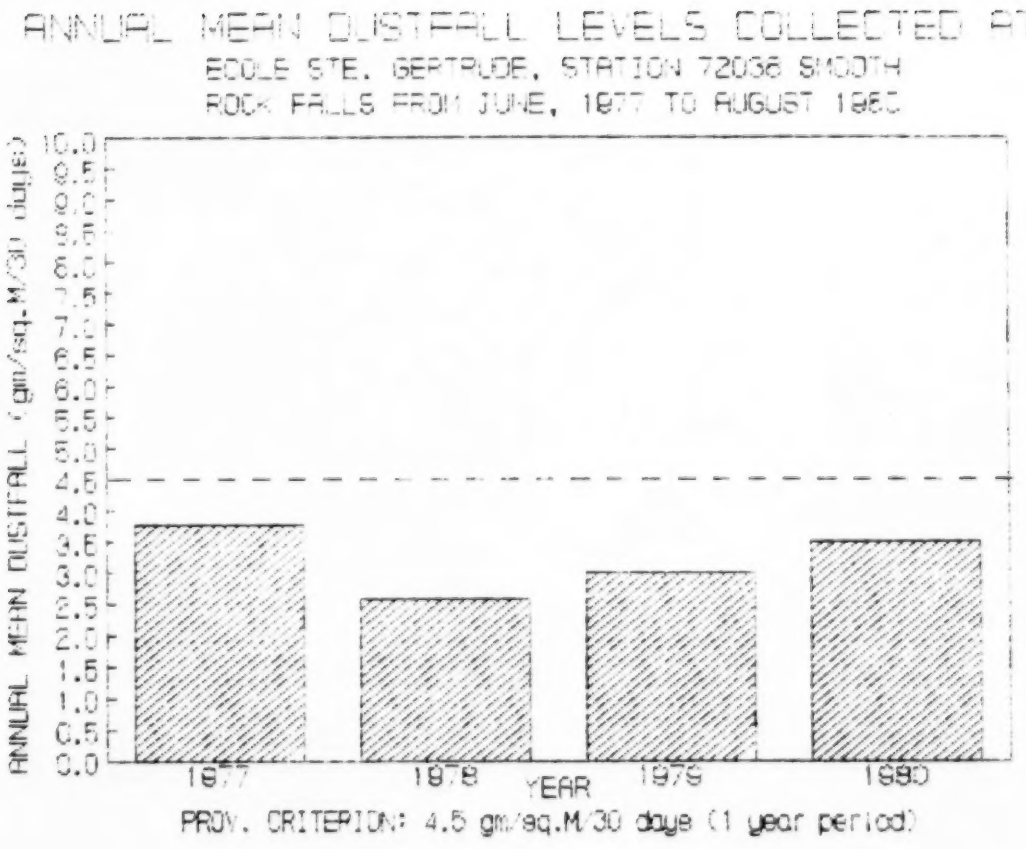

ANNUAL MEAN DUSTFALL LEVELS COLLECTED AT
ECOLE STE. GERTRUDE, STATION 72036 SMOOTH
ROCK FALLS FROM JUNE, 1977 TO AUGUST 1980
ANNUAL MEAN DUSTFALL (gm/sq.M/30 days)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
8.5
9.0
9.5
10.0
1977
1978
1979
1980
YEAR
PROV. CRITERION: 4.5 gm/sq.M/30 days (1 year period)

Figure 5

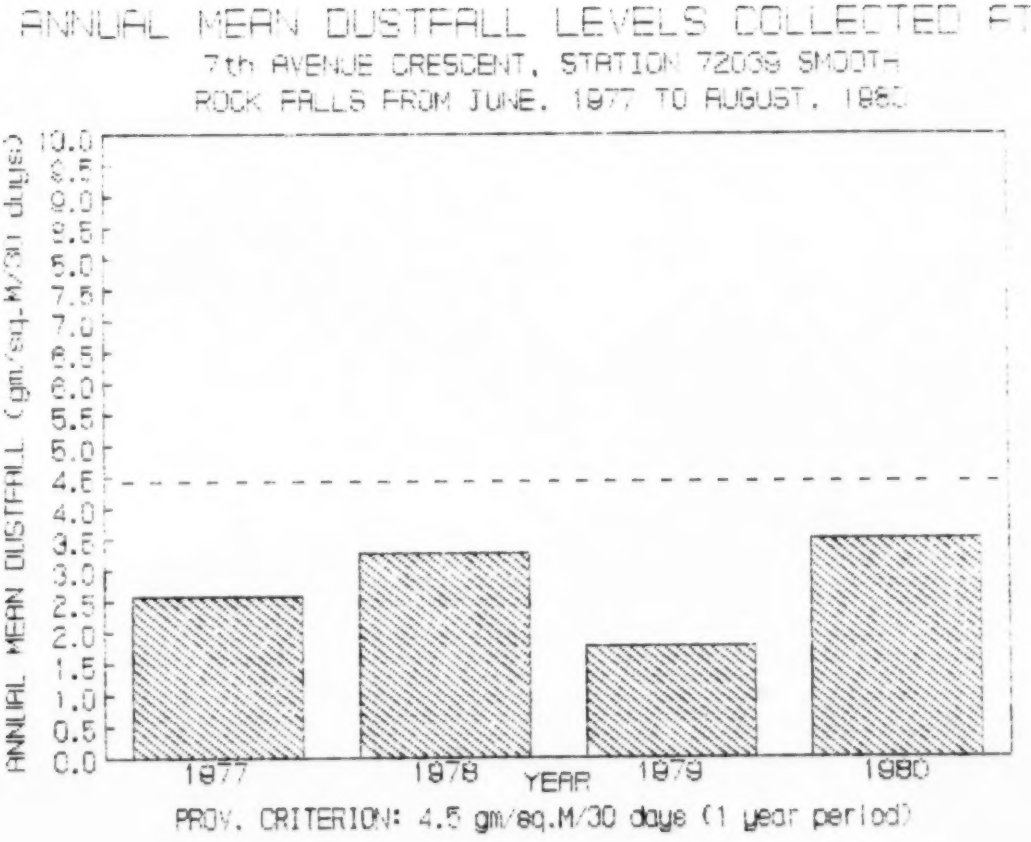
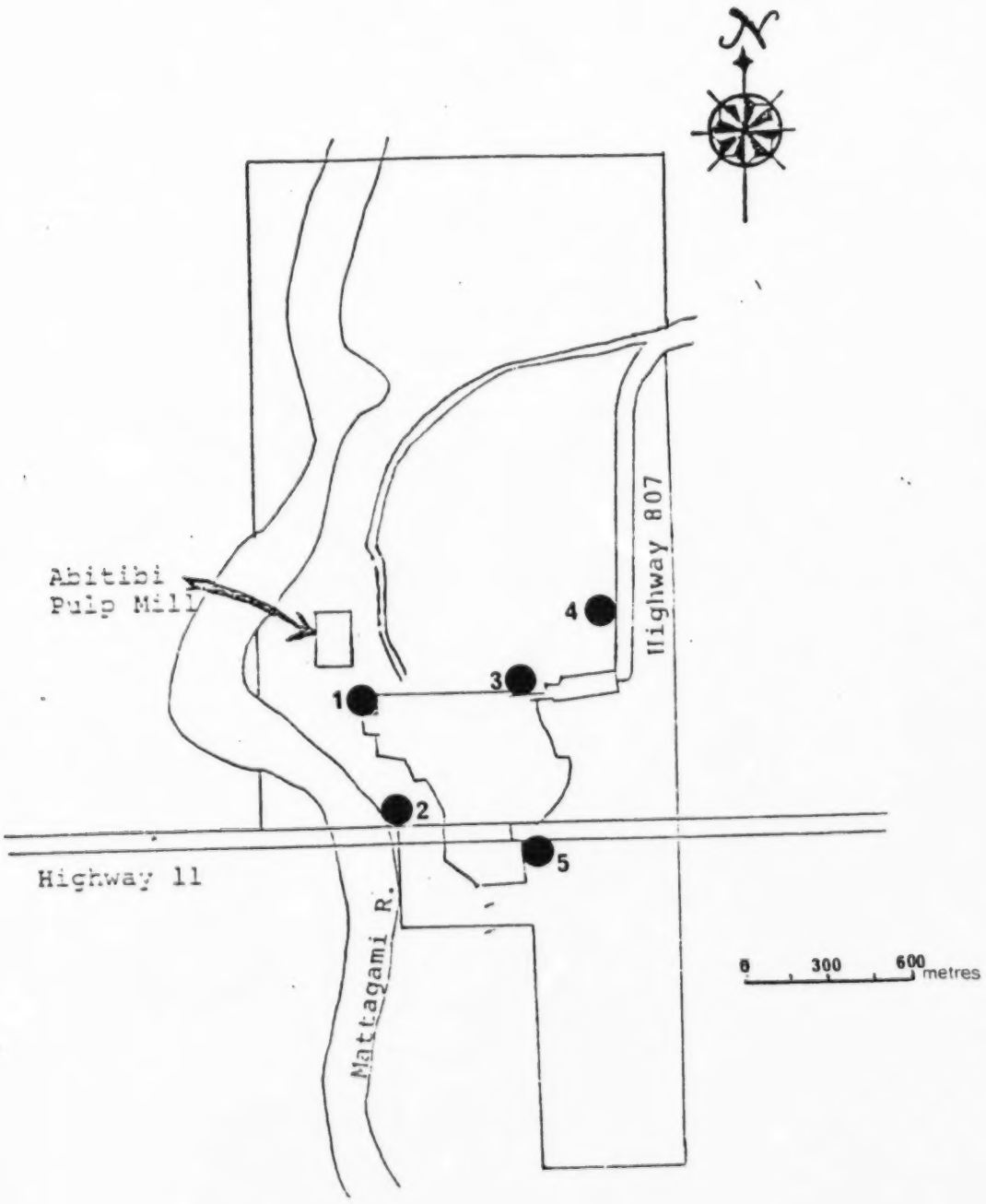

ANNUAL MEAN DUSTFALL LEVELS COLLECTED AT
7th AVENUE CRESCENT, STATION 72039 SMOOTH
ROCK FALLS FROM JUNE, 1977 TO AUGUST, 1980
ANNUAL MEAN DUSTFALL (gm/sq.M/30 days)
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1977
1978
1979
1980
YEAR
PROV. CRITERION: 4.5 gm/sq.M/30 days (1 year period)

Figure 6

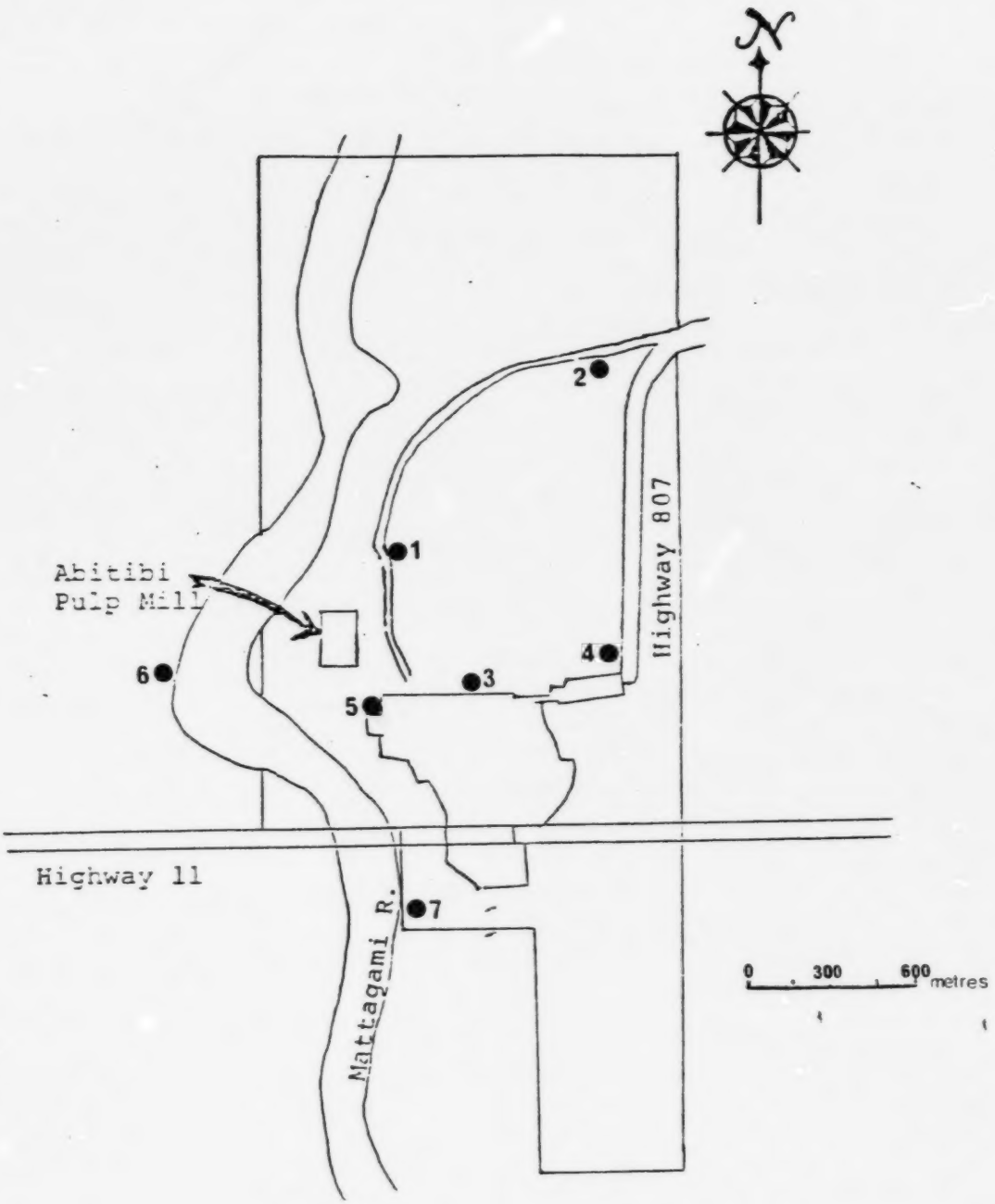
Town of Smooth Rock Falls



● - Vegetation Sampling Locations - 1974

Figure 7

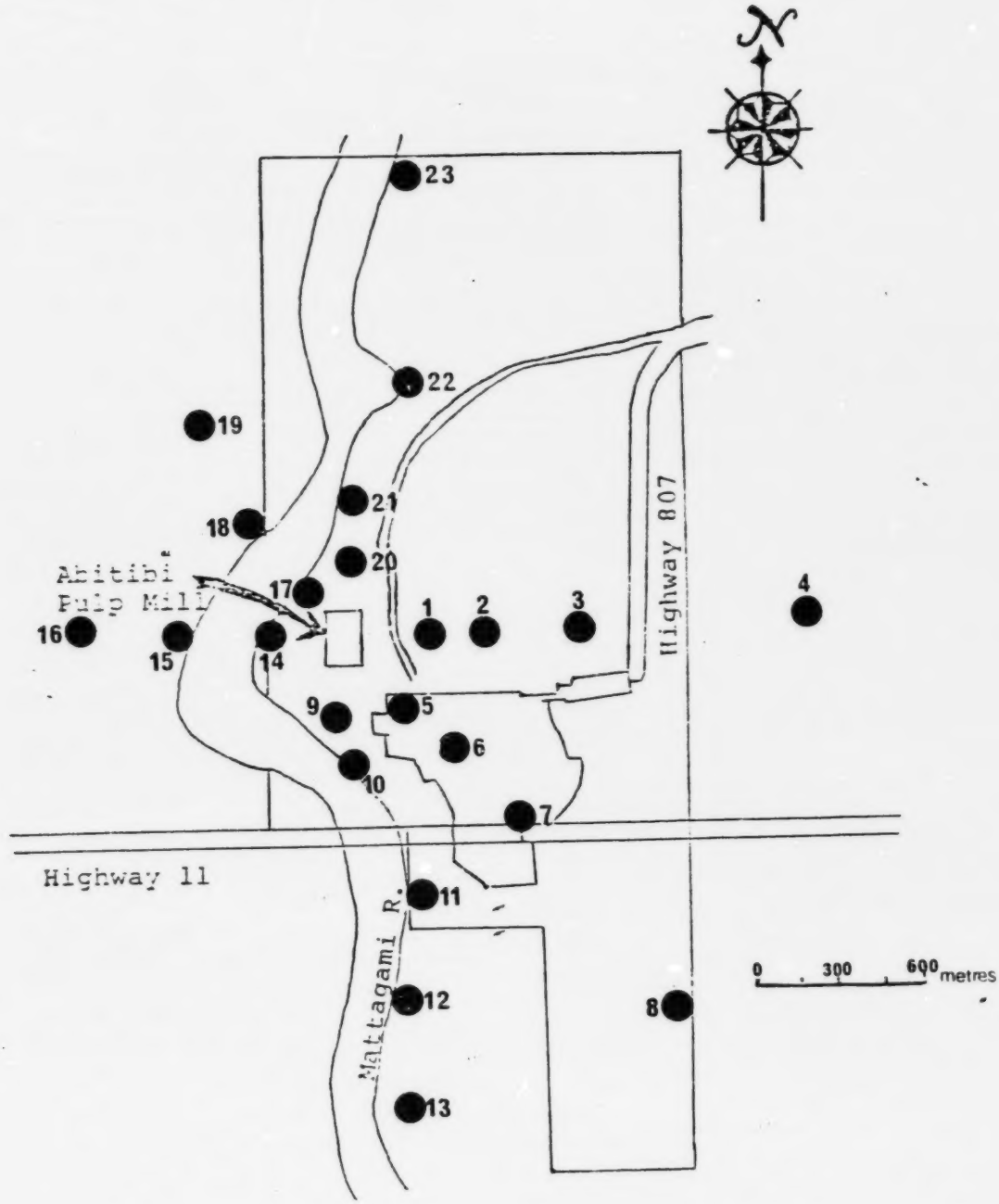
Town of Smooth Rock Falls



● Vegetation and soil sampling sites 1975-1985

Figure 8

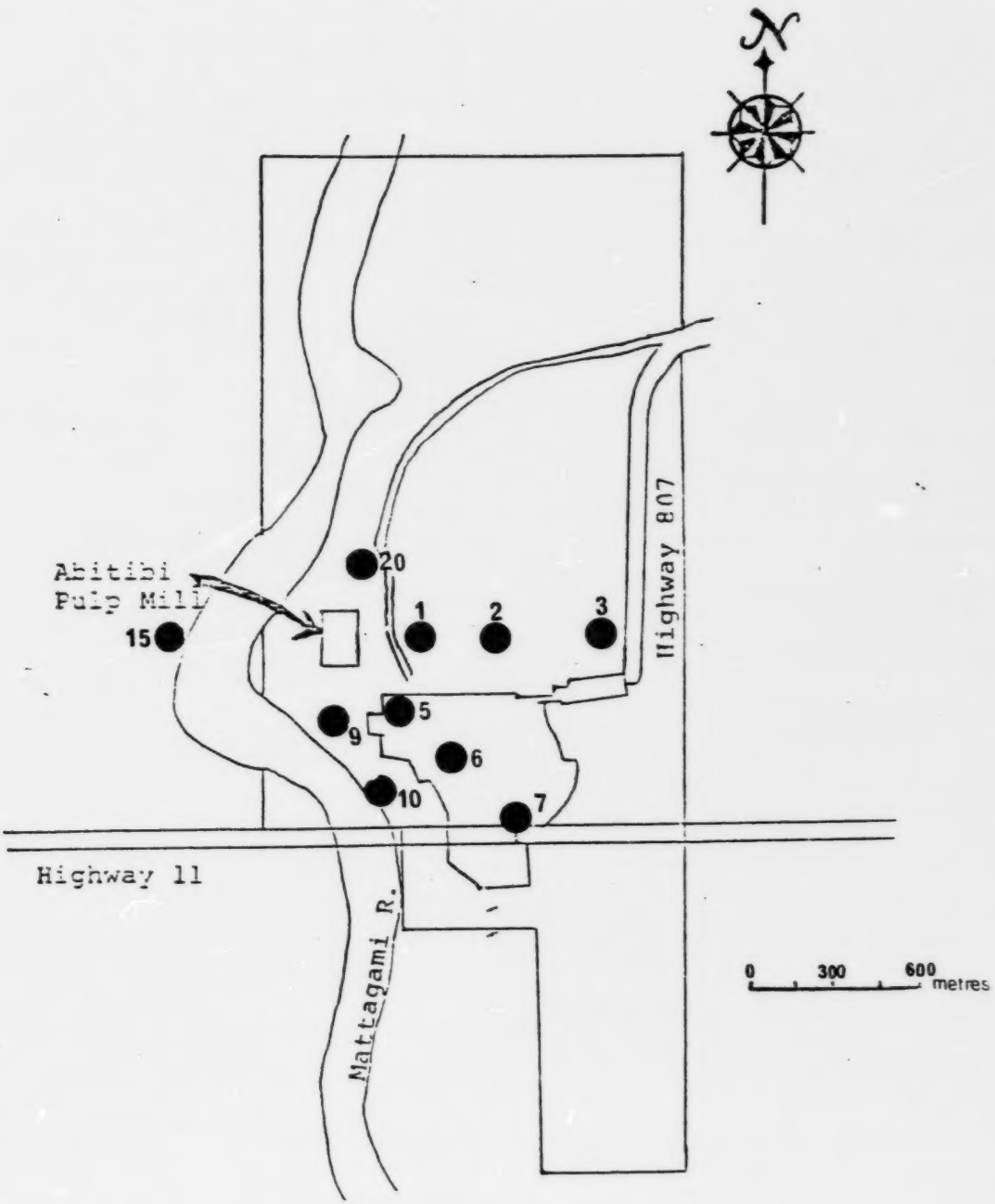
Town of Smooth Rock Falls



● - Snow sampling Locations - 1975

Figure 9

Town of Smooth Rock Falls



● - Snow Sampling Location - 1976

Figure 10

SCALE:

METRES